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# BACTERIOLOGICAL SURVEY OF THE CACHE LA POUDRE RIVER NEAR GREELEY, COLORADO, APRIL, 1972

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# BACTERIOLOGICAL SURVEY OF THE CACHE LA POUDRE RIVER NEAR GREELEY, COLORADO

APRIL, 1972

TECHNICAL SUPPORT BRANCH
SURVEILLANCE AND ANALYSIS DIVISION

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Two brief microbiological studies of the Cache La Poudre River in the Greeley, Colorado, area were conducted during April 1972 to: (1) Identify the source(s) of bacterial pollution in the reach bracketed by the foot-bridge crossing at Island Grove Park and the low head dam at 2nd Avenue; (2) develop some insight to the relative impact of storm runoff on the bacteriological quality of the river in the Greeley area. Although bacteriological degradation of the river in the Island Grove Park - 2nd Avenue reach was identified in EPA studies conducted during the last half of 1971, the source or sources were not identified since these studies were designed to assess the effect of Great Western's sugar factory effluent on water quality.

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## INTRODUCTION

Two brief microbiological studies of the Cache La Poudre River in the Greeley, Colorado, area were conducted during April, 1972, to:

(1) Identify the source(s) of bacterial pollution in the reach bracketed by the foot-bridge crossing at Island Grove Park and the low head dam at 2nd Avenue. (This reach is upstream of the effluents from the Greeley wastewater treatment plant and the Great Western sugar beet factory)

(2) Develop some insight to the relative impact of storm runoff on the bacteriological quality of the river in the Greeley area.

Although bacteriological degradation of the river in the Island Grove Park - 2nd Avenue reach was identified in EPA studies conducted during the last half of 1971, the source or sources were not identified since these studies were designed to assess the effect of Great Western's sugar factory effluent on water quality.

## STUDY AREA DESCRIPTION

The Cache La Poudre River flows from west to east along the north edge of Greeley, Colorado, and is bordered by agricultural and marsh lands, gravel pits, cattle feed lots, junk yards, a meat packing plant, a sugar beet refinery, a livestock truck-washing facility, a municipal sewage treatment facility, a city park, and residential area. All this development is located in the river flood plain and provides the potential for significant bacteriological pollution during periods of storm runoff.

In contrast to the large number of potential sources during storm runoff, there are only a limited number of direct discharges to the Cache La Pourdre River in the Greeley area. The effluent from the Greeley wastewater treatment plant enters the river downstream from the 2nd Avenue Dam. As previously reported (Ref.2) the treatment facility is severely overloaded by packing house wastes resulting in heavy bacteriological and organic loadings on the river. Effluent from the Eaton sewage treatment plant (oxidation ditch secondary treatment) flows down Eaton draw and enters the river at a point approximately 1.5 miles upstream from 2nd Avenue. The operation of the Great Western sugar factory is seasonal occurring during the winter months. The factory was not in operation during the April studies.

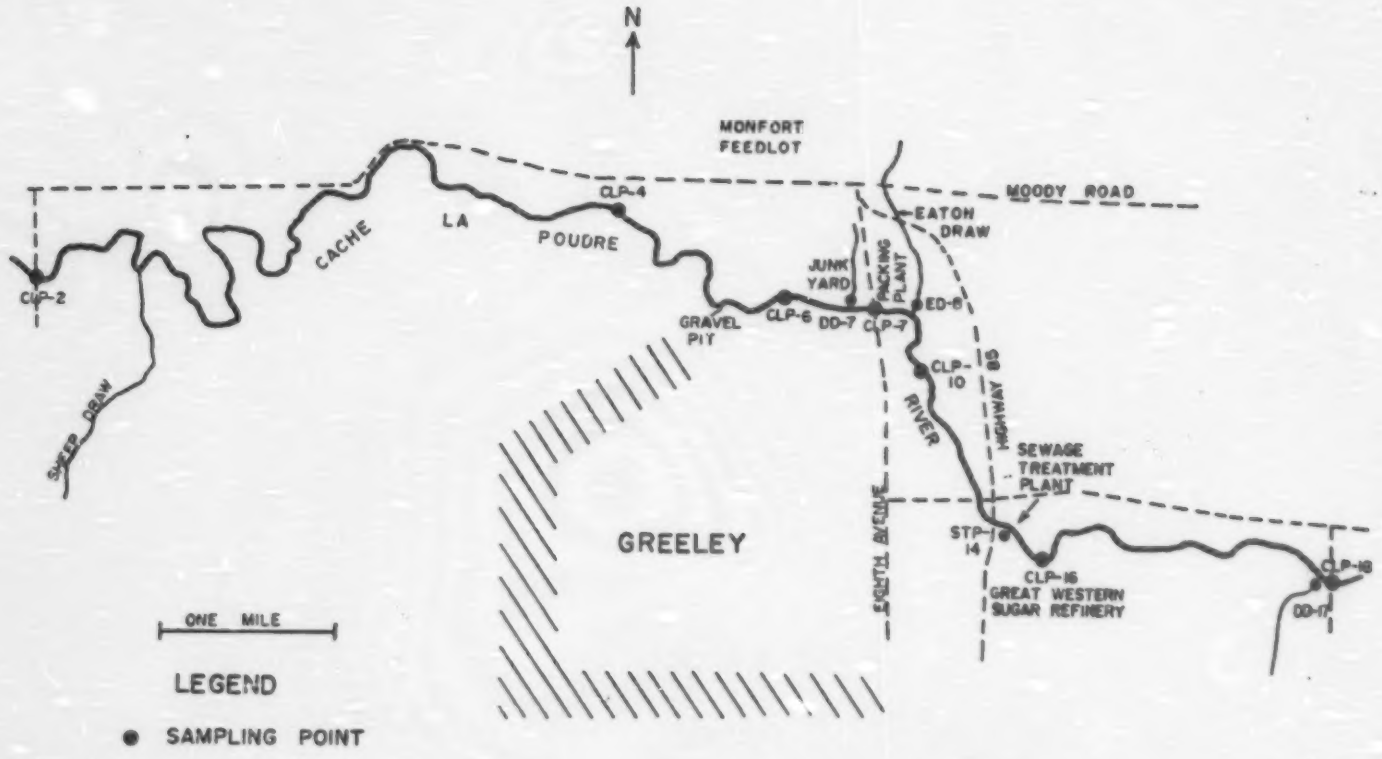


Figure 1 Map of Survey Area

With the exception of the wastewater treatment plant effluents the only other observed discharges were from a gravel pit (RM8.2), the Monfort meat packing plant (RM7.0), and several small drainage ditches containing spring water and irrigation return water. Figure 1 shows the locations of the various discharges.

## APPLICABLE WATER QUALITY STANDARDS

During 1971, the State of Colorado adopted the following coliform standards for the Cache La Pourdre River in the Greeley area: (Ref.3)

(1) Upstream from the 2nd Avenue Bridge - the highest classification is a warm water fishery (Class $B_2$). Fecal coliforms must not exceed a log-mean of 1000 per 100 ml or 2000 per 100 ml in more than 10% of the samples collected in any 30-day period.

(2) Downstream from the 2nd Avenue Bridge to the mouth - Classification as industrial and irrigational waters (Classes C and $D_1$) with no coliform limits.

## SURVEY PROCEDURES

The selection of sampling periods was based on the desirability of making bacteriological measurements during periods of normal and storm runoff conditions. During normal flow conditions a bacteriological baseline can be established for use as a reference for evaluation of data collected during times of increased bacteriological loading; i.e., storm runoff.

The time period of April 18-21, 1972, was selected as a suitable interval for the collection of baseline data in anticipation of significant storm activity within a subsequent period of 2 to 3 weeks. Precipitation (about ½ inch rainfall) did occur on April 26 and sampling was undertaken on April 27 and 28. Although the rainfall was associated with a one foot rise in the Cache La Poudre River, there did not appear to be any significant overland runoff in the Greeley area. This being the case, the increase in flow was most likely due to additional rainfall over upstream areas.

Sampling was conducted at 7 stations on the Cache La Poudre River covering a 13 mile reach (river miles 2.9 to 15.7). In addition, samples were collected from Eaton draw, two drainage ditchs, and the Greeley wastewater treatment plant. Sample station descriptions

TABLE 1

Sample Point Locations

| Station # | River Mile | Location | Sampling Point |
|---|---|---|---|
| CLP-2 | 15.7 | CLP River<br>4 miles west of Mumper Corner | Upstream side of County Road Bridge |
| CLP-4 | 9.4 | CLP River<br>Bridge at Spanish Colony | Upstream side of Bridge |
| CLP-6 | 7.8 | CLP River<br>Island Grove Park | Upstream side of Bridge |
| DD-7 | 7.4 | Drainage Ditch Located<br>Between 8th and 11th Ave. Bridges | North Bank of River |
| CLP-7 | 7.1 | CLP River<br>Eighth Avenue Bridge | Downstream Side of Bridge |
| ED-8 | 6.9 | Culvert Near Mouth of<br>Eaton Draw | Downstream End of Culvert |
| CLP-10 | 6.3 | CLP River<br>6th Avenue Bridge | Upstream Side of Bridge |
| STP-14 | 5.3 | Greeley Sewage Treatment<br>Plant | Chlorination Basin Effluent Point |
| CLP-16 | 5.2 | CLP River<br>First Bridge Below Greeley<br>Sewage Plant Outfall | Upstream Side of Bridge |
| CLP-18 | 2.9 | CLP River<br>Bridge South of Weld County<br>Airport | About 200 yds upstream of Bridge on north bank |
| DD-17 | 2.9 | Drainage Ditch South of Weld<br>County Airport | Upstream end of culvert |
| ED-1 | - | Eaton, Colorado Sewage<br>Treatment Plant | Effluent Pipe |
| ED-2 | - | Eaton Draw About 3 miles<br>Below Eaton Outfall | Upstream End of Culvert Under County Road |

are presented in Table 1 and depicted in Figure 1. At each station, surface grab samples were collected using sterile 250 ml wide-mouth bottles. Field measurements included temperature, stream depth, visual assessment of the water condition (clear, turbid, etc.) and, in the case of the wastewater treatment plant effluent, the chlorine residual. The residual chlorine values are shown in Table 5 in the Appendix.

All samples were analyzed for total and fecal coliforms by the millipore filter method. Selected samples were also analyzed for fecal streptococcus. Analyses were conducted in accordance with the 13th Edition of "Standard Methods for the Examination of Water and Wastewater." (Note: The Biology Department, University of Northern Colorado, graciously donated laboratory space to EPA for the conduct of bacteriological analyses)

## RESULTS AND DISCUSSION

### General

A total of 72 water samples were collected from the Cacha La Poudre River and its tributaries during the two studies. Analysis of each sample for total and fecal coliforms yielded results which are summarized in Table 2. Colorado water quality standards for the Cache La Poudre River upstream from the 2nd Avenue Bridge require that fecal coliform bacteria not exceed a log-mean value of 1000 per 100 mls. In this study, 30 samples were collected from 5 stations above the 2nd Avenue Bridge and only 3 (10%) of these samples exceeded 1000 fecal coliforms per 100 ml. The average log-mean value for the 5 river stations upstream from the 2nd Avenue Bridge was 212 fecal coliforms per 100 ml. The state standard was, therefore, not violated.

### Rainfall Effects

On April 26, 1972, the Greeley area received about ½ inch of rainfall with an undetermined amount of rainfall occurring further upstream. The following day the river was higher by about one foot, and, as shown in Tables 1 and 2 in the Appendix, there was an associated increase (by a factor of about 5) in total and fecal coliform concentrations at each station. Due to the dry soil conditions before the rain in the Greeley area, no significant surface runoff was observed. The increase in total and fecal coliforms was likely caused by bacteria washed from the river banks in adjacent pastureland and feedlot areas and by bacteria brought downriver from unknown sources by the increased river flow.

When the river returned to its original depth on April 28, the total and fecal coliform concentrations likewise returned to their original levels.

TABLE 2

Summary of Total and Fecal Coliform Counts

| Sta. | Location | Total Coliforms/100ml | | | | Fecal Coliforms/100ml | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Samples | Maximum | Minimum | Log-Mean Value | Samples | Maximum | Minimum | Log-Mean Value |
| CLP-2 | CLP-River 4 mi. west of Mumper Corner at County Road Bridge | 6 | 7100 | 500 | 2024 | 6 | 1300 | 150 | 317 |
| CLP-4 | CLP River Bridge at Spanish Col. | 6 | 3300 | 260 | 934 | 6 | 670 | 20 | 145 |
| CLP-6 | CLP River Footbridge Is.Grove Pk. | 6 | 3600 | 190 | 466 | 6 | 1200 | 50 | 188 |
| DD-7 | Drainage Ditch in No. Bank between 8 & 11th Avenue Bridges | 6 | 9200 | 720 | 2777 | 6 | 6400 | 100 | 1281 |
| CLP-7 | CLP River Eight Avenue Bridge | 6 | 2900 | 210 | 613 | 6 | 1400 | 50 | 215 |
| ED-1 | Eaton, Colc.Sewage Treatment Plant Effl. | 5 | 5000 | 1700 | 3283 | 5 | 1100 | 180 | 579 |
| ED-2 | Eaton Draw about 3mi. below Eaton Sewage Outfall | 1 | 1100 | 1100 | 1100 | 1 | 40 | 40 | 40 |
| ED-8 | Calvert near Mouth of Eaton Draw | 6 | 35000 | 200 | 3724 | 6 | 1800 | 60 | 469 |
| CLP-10 | CLP River 6th Avenue Bridge | 6 | 48000 | 180 | 1002 | 6 | 1000 | 110 | 195 |
| STP-14 | Greeley Sewage Treat. Plant Effluent | 6 | 6700000 | 7600 | 888500 | 6 | 740000 | 100 | 8880 |
| CLP-16 | CLP River First Bridge below Greeley Sewage Outfall | 6 | 990000 | 1100 | 30550 | 6 | 180000 | 40 | 3664 |
| DD-17 | Drainage Ditch South of Weld County Airport | 6 | 5000 | 400 | 1341 | 6 | 520 | 80 | 171 |
| CLP-18 | CLP River Upstream of Bridge South of Weld County Airport | 6 | 460000 | 500 | 15375 | 6 | 34000 | 340 | 3934 |

## Drainage Ditches

The concentration of total coliforms in the river increased by more than 100% (as the log-mean measurement) between the Island Grove Park footbridge and the 6th Avenue Bridge. Fecal coliforms increased by only 3½% in this same stretch of river. The increase in total coliforms was due primarily to the two tributary streams entering the river on either side of the Monfort Packing Plant (DD-7 and ED-8). Eaton Draw (ED-8) contains the sewage effluent from Eaton, Colorado, plus additional irrigation return water. The drainage ditch (DD-7) flows through a marshy, junk-littered area and then into the river.

## Sewage Treatment Plants

It can easily be seen from Table 2 that the Greeley sewage treatment plant generally produces a gross bacterial overload on the Cache La Poudre River. This contamination is due primarily to the extremely overloaded condition of the sewage treatment plant caused by meat packing wastes from the Monfort Packing Plant. Although heavy chlorine dosages were commonly employed at the sewage treatment plant, adequate disinfection was often not accomplished. For example, Table 2 in the Appendix shows that fecal coliform counts were above 450,000 per 100 ml on 3 out of 6 days during the study. On the remaining 3 days disinfection reduced the fecal coliform concentration to 200 per 100 mls or less. It is clear that the Cache La Poudre River would benefit greatly from more reliable disinfection at the Greeley sewage treatment plant.

This study also shows that the Eaton sewage treatment plant (oxidation ditch secondary treatment) has generally effective chlorination. Results show a residual log-mean fecal coliform value of only 579 per 100 mls, which is less than the warm water fishery standard adopted by the State of Colorado for the reach of the Cache La Poudre River affected by this discharge.

## Comparison With Earlier Surveys

As a matter of interest the results of total and fecal coliform analyses from three previous surveys of the Cache La Poudre River are presented with similar data from this survey in Table 3. The surveys of September and December, 1971 (Ref. 1) were conducted jointly by the National Field Investigations Center - Denver and Region VIII-EPA, whereas this survey and the November, 1971, survey (Ref.2) were conducted by Region VIII only. Table 3 shows a significant variation for the September and November surveys while there is fairly close agreement between the April and December survey results. There is not enough data to determine the exact causes for similarity or disagreement in survey results except for the November survey. During that survey, the Great Western sugar beet refinery was in full operation and undoudtedly contributed to the coliform increase in the lower stream reach.

TABLE 3

Log Mean Total and Fecal Coliform Counts for Several Different Surveys on the Cache La Poudre River

| Sta. # | Location | Log-Mean Total Coliforms/100ml | | | | Log-Mean Fecal Coliforms/100ml | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *Sept. 13-15/71 | **Nov. 16-18/71 | *Dec.6,7 13-15/71 | Apr.18-21 27-28/72 | *Sept. 13-15/71 | **Nov. 16-18/71 | *Dec.6,7 13-15/71 | Apr.18-21 27-28/72 |
| CLP-4 | CLP River Bridge at Spanish Colony | 9600 | | | 934 | 640 | 300 | | 145 |
| CLP-6 | CLP River Footbridge at Island Grove Park | | 960 | | 466 | | | | 188 |
| CLP-7 | CLP River 8th Ave. Bridge | | 2298 | | 613 | | 212 | | 215 |
| ED-8 | Culvert Near Mouth of Eaton Draw | | | | 3724 | | | 500 | 469 |
| CLP-10 | CLP River 6th Ave. Bridge | 20000 | 7266 | 1900 | 1002 | 3200 | 2569 | 220 | 195 |
| STP-14 | Greeley Sewage Treatment Plant Effluent | | 4879000 | | 898500 | | 22000 | | 8880 |
| CLP-16 | CLP River First Bridge Below Greeley Sewage Outfall | 38000 | 429400 | 47000 | 30550 | 2500 | 226500 | 3400 | 3664 |
| CLP-18 | CLP River Upstream of Bridge South of Weld County Airport | | 525600 | | 15375 | | 134300 | | 3934 |

* Values from National Field Investigations Center Report [1]

** Region VIII EPA Report [2] - Laboratory Analysis by Colorado State Health Dept.

## SUMMARY

The findings which relate to the occurance and distribution of total and fecal coliforms in the Cache La Poudre River are the following:

1. Fecal coliform standards for that portion of the river classified as a warm water fishery were not exceeded at any sample location.

2. The primary sources of bacteriological pollution between the Island Grove Park (CLP-6) and Second Avenue are:

    a) A drainage ditch flowing through a junk yard near the north river bank at Station DD-7.

    b) Eaton Draw which carries treated municipal sewage from Eaton, Colorado, and irrigation runoff from nearby agricultural lands.

3. Total and fecal coliform densities increased significantly (by a factor of about 5) after a rainfall of ½ inch in the Greeley area and an associated river rise of about one foot. This increase was likely caused by bacteria washed from the stream banks in adjacent pastureland and feedlot areas and by bacteria brought downriver from unknown sources by the increased river flow. The same pattern of decreased water quality during runoff periods can be expected in the future.

4. The Greeley sewage treatment plant often does not provide adequate disinfection to the discharged effluent. Fecal coliforms varied from >100 to 740,000 per 100 ml. The quality of this effluent should improve significantly with the construction of an alternate sewage treatment facility for the Monfort Packing Plant wastes.

5. Total coliform densities increased by more than 100% primarily as a result of the two tributary streams on either side of the Monfort Packing Plant (RM 7.4 to 6.9). These two flows are the sources for the high coliform counts found during the November, 1971 survey in the stream reach upstream from the sewage plant and sugar beet refinery discharges.

6. Data from this survey agree closely with results from the December, 1971 survey but differ markedly from the September and November, 1971 survey results. The explanation for the high coliform concentrations in November is that the Great Western sugar beet refinery was in full operation and contributed significant wasteloads at that time.

## REFERENCES


1. Report on Effects of Waste Discharges on Water Qualtiy of the Cache La Poudre and South Platte Rivers - Greeley Area, National Field Investigations Center - Denver and Region VIII, Denver, Colorado, February, 1972.

2. Summary of a Water Quality Survey - Greeley, Colorado, November 16-19, 1971, Region VIII. EPA. Denver, Colorado, July, 1972.

3. Water Quality Standards and Stream Classification, Water Pollution Control Commission, Colorado Department of Health, 1971.

# APPENDIX

## Data Summaries

TABLE 1

Total Coliforms at all Stations
Counts/100ml

| Station # | River Mile | 4/18 | 4/19 | 4/20 | 4/21 | 4/27 | 4/28 |
|---|---|---|---|---|---|---|---|
| CLP-2 | 15.7 | 500 | 600 | 3900 | 2300 | 7100 | 3600 |
| CLP-4 | 9.4 | 420 | 350 | 3300 | 260 | 2500 | 2100 |
| CLP-6 | 7.8 | 320 | 270 | 580 | 190 | 3600 | 300 |
| DD-7 | 7.4 | 9200 | 4000 | 1600 | 2300 | 4700 | 720 |
| CLP-7 | 7.1 | 260 | 430 | 340 | 210 | 2900 | 2300 |
| ED-8 | 6.9 | 12000 | 3900 | 2200 | 200 | 35000 | 3700 |
| CLP-10 | 6.3 | 580 | 550 | 400 | 180 | 48000 | 920 |
| STP-14 | 5.3 | 6700000 | 480000 | 720000 | 7600 | 4300000 | 6500000 |
| CLP-16 | 5.2 | 990000 | 1700 | 3800 | 1100 | 680000 | 170000 |
| CLP-18 | 2.9 | 13000 | 500 | 8000 | 4600 | 460000 | 120000 |
| DD-17 | 2.9 | 800 | 5000 | 400 | 450 | 4500 | 1800 |
| ED-1 | - | - | 3400 | 5000 | 1700 | 4400 | 3000 |
| ED-2 | - | - | - | 1100 | - | - | - |

TABLE 2

Fecal Coliforms at all Stations
Counts/100ml

| Station # | River Mile | 4/18 | 4/19 | 4/20 | 4/21 | 4/27 | 4/28 |
|---|---|---|---|---|---|---|---|
| CLP-2 | 15.7 | 370 | 150 | 440 | 160 | 1300 | 200 |
| CLP-4 | 9.4 | 150 | 220 | 330 | 70 | 610 | 20 |
| CLP-6 | 7.8 | 50 | 75 | 220 | 60 | 1200 | 120 |
| DD-7 | 7.4 | 6400 | 3200 | 1400 | 100 | 2200 | 700 |
| CLP-7 | 7.1 | 140 | 240 | 140 | 50 | 1400 | 300 |
| ED-8 | 6.9 | 1800 | 500 | 1100 | 60 | 300 | 600 |
| CLP-10 | 6.3 | 140 | 230 | 130 | 110 | 1000 | 120 |
| STP-14 | 5.3 | 740000 | >100 | 100 | 200 | 460000 | 720000 |
| CLP-16 | 5.2 | 180000 | 100 | 300 | 40 | 80000 | 140000 |
| CLP-18 | 2.9 | 6500 | 340 | 830 | 2200 | 27000 | 34000 |
| DD-17 | 2.9 | 120 | 250 | 90 | 80 | 520 | 220 |
| ED-1 | - | - | 1000 | 330 | 1100 | 180 | 1000 |
| ED-2 | - | - | - | 40 | - | - | - |

TABLE 3

Water Temperatures at all Stations
°F

| Station # | River Mile | 4/18 | 4/19 | 4/20 | 4/21 | 4/27 | 4/28 |
|---|---|---|---|---|---|---|---|
| CLP-2 | 15.7 | 51 | 47 | 44 | 52 | 42 | 54 |
| CLP-4 | 9.4 | 52 | 48 | 48 | 54 | 42 | 54 |
| CLP-6 | 7.8 | 53 | 48 | 49 | 52 | 42 | 50 |
| DD-7 | 7.4 | 53 | 48 | 50 | 57 | 42 | 54 |
| CLP-7 | 7.1 | 53 | 47 | 49 | 51 | 42 | 49 |
| ED-8 | 6.9 | 53 | 46 | 52 | 52 | 42 | 48 |
| CLP-10 | 6.3 | 55 | 49 | 53 | 52 | 44 | 49 |
| STP-14 | 5.3 | 62 | 58 | 64 | 63 | 62 | 64 |
| CLP-16 | 5.2 | 55 | 50 | 56 | 52 | 46 | 48 |
| CLP-18 | 2.9 | 56 | 50 | 54 | 50 | 46 | 47 |
| DD-17 | 2.9 | 55 | 50 | 50 | 47 | 43 | 44 |
| ED-1 | - | - | 54 | 56 | 55 | 50 | 53 |
| ED-2 | - | - | - | 58 | - | - | - |

TABLE 4

Time of Sample Collection

| Station # | River Mile | 4/18 | 4/19 | 4/20 | 4/21 | 4/27 | 4/28 |
|---|---|---|---|---|---|---|---|
| CLP-2 | 15.7 | 0915 | 1210 | 0845 | 1100 | 0930 | 1028 |
| CLP-4 | 9.4 | 1000 | 1135 | 0910 | 1035 | 0945 | 1013 |
| CLP-6 | 7.8 | 1015 | 1100 | 0940 | 1015 | 1000 | 1000 |
| DD-7 | 7.4 | 1100 | 1025 | 0955 | 1000 | 1006 | 0950 |
| CLP-7 | 7.1 | 1130 | 0950 | 1005 | 0950 | 1020 | 0938 |
| ED-8 | 6.9 | 1145 | 0930 | 1045 | 0935 | 1050 | 0902 |
| CLP-10 | 6.3 | 1215 | 0920 | 1100 | 0925 | 1055 | 0855 |
| STP-14 | 5.3 | 1300 | 0900 | 1120 | 0910 | 1130 | 0840 |
| CLP-16 | 5.2 | 1235 | 0840 | 1130 | 0855 | 1140 | 0830 |
| CLP-18 | 2.9 | 1330 | 0750 | 1145 | 0835 | 1150 | 0815 |
| DD-17 | 2.9 | 1345 | 0810 | 1200 | 0835 | 1155 | 0810 |
| ED-1 | - | - | 1505 | 1400 | 1210 | 1030 | 0920 |
| ED-2 | - | - | - | 1330 | - | - | |

TABLE 5

Chlorine Residual
PPM

| Station # | River Mile | 4/18 | 4/19 | 4/20 | 4/21 | 4/27 | 4/28 |
|---|---|---|---|---|---|---|---|
| CLP-2 | 15.7 | - | - | - | - | - | - |
| CLP-4 | 9.4 | - | - | - | - | - | - |
| CLP-6 | 7.8 | - | - | - | - | - | - |
| DD-7 | 7.4 | - | - | - | - | - | - |
| CLP-7 | 7.1 | - | - | - | - | - | - |
| ED-8 | 6.9 | - | - | - | - | - | - |
| CLP-10 | 6.3 | - | - | - | - | - | - |
| STP-14 | 5.3 | 0 | 0.5 | 0.5 | 0.5 | 0 | 0 |
| CLP-16 | 5.2 | 0 | 0 | 0.1 | 0.1 | - | 0 |
| CLP-18 | 2.9 | - | - | - | - | - | - |
| DD-17 | 2.9 | - | - | - | - | - | - |
| ED-1 | - | - | 0.1 | 0.1 | 0.25 | 0.5 | 0.5 |
| ED-2 | - | - | - | - | - | - | - |